Philippine Red Cross Online Blood Bank Management Information System

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ABSTRACT

Philippine Red Cross (PRC) is one of the major suppliers of blood in the country. Blood Centers of the PRC all over the country are having a hard time managing and communicating their data from one blood center to another. Generating monthly reports is also challenging on their part since records are unorganized and data retrieval is time-consuming. To address the issue, the Philippine Red Cross Online Blood Bank Management Information System (PRCOBBMIS) was developed. It is a web-based environment that provides efficient profiling management and retrieval of data. It is a system designed to manage blood stock inquiries online and even through Short Messaging Service (SMS). The system was developed using V-model to lessen errors during the development of the system. PHP programming language was used in the development and MySQlwas used for the database tool. Ozeki and Visual C# was used in the integration of SMS into the system. Having been developed using the web architecture, the system provided a more effective networking ability that will help PRC employees in proficiently profiling their donors, keeping their blood stock data updated and generating statistical reports.

Introduction

The global market for blood banking and blood products is forecast to reach US$36 billion by the year 2015. The aging population, emergence of new infections and efforts to make available qualitative blood the world over are fuelling market growth. Stringent regulatory and healthcare policies adopted across the globe are also influencing the market for blood banking and blood products.

In the Philippines, the main governing body for the Blood Transfusion Services (BTS) is the National Council for Blood Services chaired by the DOH with the Philippine Red Cross Society as Deputy Chair. There are several technical subcommittees including one for blood donor mobilization, which is chaired by the Philippine Red Cross Society. Currently, there are at least 2,000 licensed health facilities across the country and at least 200 authorized blood banks (BB). However, these are not part of a single system, so there remains a high degree of fragmentation and a high need for centralization and rationalization (Global Industry Analyst, Inc., 2016).

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The Philippine Red Cross (PRC), founded in 1947, is a premier humanitarian organization in the country, committed to providing quality life-saving services that protect the life and dignity especially of indigent Filipinos in vulnerable situations. In all its 65 years of reputable existence, where it used to be involved only in providing blood and in disaster-related activities, the Philippine Red Cross now offers a broader array of humanitarian services ranging from preventive medicine to therapeutic counseling, to youth leadership (Philippine Red Cross.,2017).

PRC has one National Blood Center, and it is located in Bonifacio Drive, Port Area, Manila. There are three PRC regional blood centers in the country, namely: Eastern Visayas Regional Blood Center (EVRBC) located at Osmeña Blvd., Cebu City; Western Visayas Regional Blood Center (WVRBC) located at Bonifacio Drive, Iloilo City; and Mindanao Regional Blood Center (MRBC) located at Capitol Compound, Cagayan de Oro City. Under this regional blood, centers are blood service facilities. On the other hand, WVRBC, together with all other regional blood centers and blood service facilities, are communicating to the PRC national headquarters with the use of the phone, e-mail, and fax.

In line with the strategic directions of national voluntary blood services program under the Department of Health, the WVRBC recruits voluntary blood donors, collects blood for testing, and processing into blood and blood products like packed red blood cells (PRBC), platelets and fresh frozen plasma.

These processed blood components are delivered directly to the hospital blood stations to make blood readily available to the patients, especially during emergency cases. By doing so, lives are saved because the turnaround time of getting blood from the Red Cross to the hospital has been eliminated.

On the contrary, blood served directly to the patients confined at the hospitals are advised to recruit blood donors to help support the blood program at the same time ensure the continuity of blood stocks for future patients.

To guarantee the acceptability of these blood donors going to WVRBC, a donor database is necessary to assure that donors are qualified to donate blood. That is, the frequency of donation must be at least once every three months, and they must be non-reactive to laboratory test for the five transfusion-transmissible diseases such as Hepatitis B, Hepatitis C, HIV-AIDS, Syphilis, and Malaria.

The PRC-WVRBC started to computerize its donor records in 2004 and is only accessible to the center itself. They are utilizing one computer to save all files, and they are using JAVA and SQL.

The donor database consists of the following information: source of donor (patient directed / walk-in), date of blood donation, name of blood donor, complete address of the donor, age, sex, serial no. of blood, blood type, type of bag used, rhesus (Rh) factor and laboratory results. They issue donor cards but it does not include the donor's photo that can

verify donor's identity. The laboratory results are very confidential that only the authorized medical officer(s) and nurse(s) can access the results. But staff members who are the first to screen the donors don't have any means of identifying if the donor was tested positive in one of the five transfusion-transmissible diseases in other blood centers unless they test the blood themselves. They also have a difficulty in identifying donors that have already donated blood in less than three months, especially if they come from other regions.

Since the PRC-WVRBC does not have their local website yet, they are just utilizing the website of the PRC national headquarters for information dissemination purposes.

Philippine Red Cross Online Blood Bank Management Information System (PRCOBBMIS) was developed out of the prevailing problems encountered by PRC. PRCPBBMIS is a web-based environment that provides efficient profiling management and retrieval of data. It is a system designed to manage blood stock inquiries online and even through Short Messaging Service (SMS).

Methodology

The Philippine Red Cross Online Blood Bank Management Information System (PRCOBBMIS) was based on the Government to Citizen (G2C) Theory. G2C is the communication link between a government and private individuals or residents.

In the case of PRCOBBMIS, the government links with the Philippine Red Cross and their allied hospitals to cater to the services that they provide to the public such as blood testing, extraction, storage and dispensing.

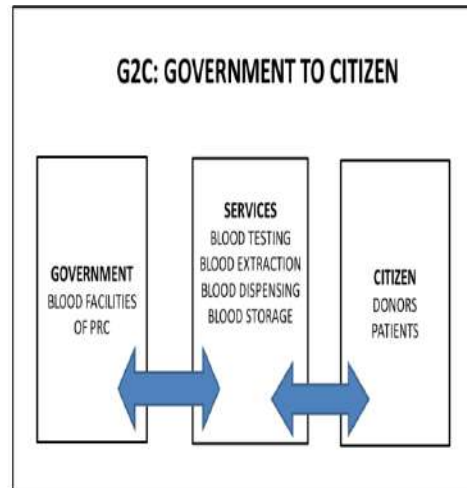Those who are under "citizen" are the patients and donors needing the services.
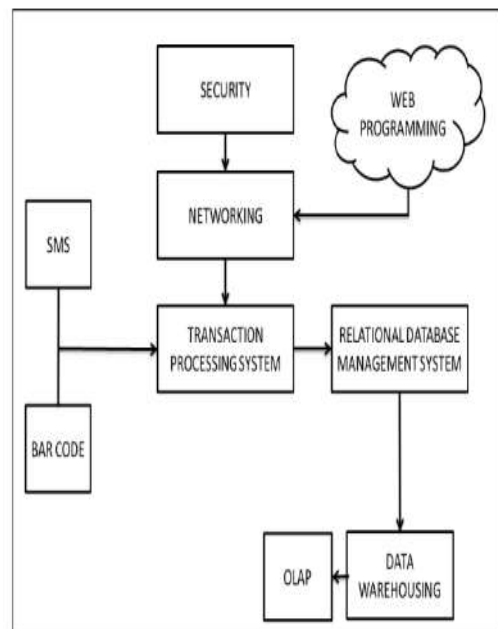

Figure 1. PRCOBBMIS

Figure 2. Conceptual Framework of PRCOBBMIS

The Conceptual Framework of PRCOBBMIS is composed of the Security System with Internet connection; Networking, Transaction Processing System (TPS) with Short Message Service (SMS) and Barcode, Relational Database Management System (RDBMS), Data Warehousing, Data Mining and Online Analytical Processing (OLAP). These technologies were formed into an integrated system.

Security

To ensure the security of the system from hackers, bycrypt is used which is a password hashing function. To access the system, the PRC employee must first register with the administrator, and he will be given his username and password which will be used to log-in. Once the username and password are verified by the system, then the user can access data according to the level of accessibility the administrator has given to that user.

The usernames and passwords are given by the administrator for easy control of users in the system. However, as soon as the employee can log–in, he has the option to change his password.

Networking

Wide area networking (WAN) is used in this proposal since PRC is a national organization and this is used on all PRC blood centers nationwide, for easy access and sharing of essential blood and blood donor data. Internet connection is vital for the user to access the system. As long as they are connected to the internet, they can pull up any data connected to the system.

Transaction Processing System

TPS ensures a smooth flow of transaction, isolating particular transactions that have no credible assurance of the collected data's authenticity in this system.

It also provides accurate information that guarantees immediate action to negotiations made by persons and companies involved.

Atomicity is one of the characteristics of TPS. In the PRCOBBMIS, atomicity is implemented such as if a particular process is not fully completed.

Therefore, the transaction does not exist. It also has a real-time processing feature in which if the blood donated has negative results from any tested diseases, it automatically adds up to the total list of available blood in that blood bank.

Short Message Service

SMS is a feature that is incorporated into the system for inquiry purposes. In case a patient is isin need of blood, and the blood type is not available in the hospital's blood bank, the medical personnel, for instance, can just use his mobile phone and text his inquiry to the system instead of running to a computer with internet connection.

As the message reaches the system, automatically the system looks for available supply on that particular blood type on all PRC blood centers registered on the system and replies back to the medical personnel.

They can immediately contact the specific PRC blood center that has an available supply. This feature is

accessible to those who are registered in the system.

Barcode

The system allows barcode entry for easy retrieval of donor profile and blood information.

Relational Database Management System

RDBMS facilitates the organization, storage, access, security, and integrity of data and eliminates data redundancy. It stores the data in a set of tables, each of which contains a unique identifier.

The system was developed using MySQL and the programming language was PHP. MySQL is a relational database management system (RDBMS) based on SQL (Structured Query Language) that runs as a server providing multi-user access to some databases.

MySQL is selected in this system because of its cross-platform capabilities. It means that one can develop his database on a Windows laptop and deploy on Windows Server 2003, a Linux server, an IBM mainframe, or an Apple XServe, just to name a few potential platforms.

This gives a lot of versatility when choosing server hardware. One can even set up replication using a master on a Windows platform with Linux slaves. (Hillyer, M. 2004).

Although under constant development, MySQL Server today offers a variety of functions. Its connectivity, speed and security make MySQL Server highly suited for accessing databases on the Internet.

Data Warehousing

Data warehousing in the system is combining data from multiple and usually varied sources into one comprehensive and easily manipulated database. Common accessing systems for data warehousing include queries, analysis, and reporting.

Because data warehousing creates one database, in the end, the number of sources can be anything you want it to be, provided that the system can handle the volume. The final result, however, is similar data, which can be more easily manipulated. Data warehousing is responsible for integrating data from multiple and usually varied sources into one comprehensive and easily manipulated database. For example, any data connected to the donor's name is seen such as the serial number of the blood bag, the test results, the patients who used the different components of the donor's blood, etc.

Online Analytical Processing

OLAP is responsible for generating the data required for report generation. Such reports have multidimensional data like for instance, in a certain month it displays all donors that are men under ages 20-30 years old having blood type "A". Below is Table 1 that shows the comparison of PRCOBBMIS to other existing systems from other countries.

Table 1
Comparison of PRCOBBMIS to Other Existing Systems from Other Countries

No.	Title	Donor Profiling	Donor Management	Blood Record Management	SMS Blood Stock Query	Online Blood Stock Query	Report Generation
1	A Web-based blood donor Management Information system for the Red Cross Society, Uganda (WBBDMI)	✓	✓	✓			✓
2	Online blood donation reservation and management system in Jeddah	✓	✓				✓
3	A study on blood bank Management	✓	✓	✓			
4	Online Blood Donation Reservation and Management System (OBDRMS)	✓	✓	✓		✓	
5	Blood Bank Management System	✓	✓			✓	
6	Android Blood Donor Life Saving Application in Cloud Computing	✓	✓		✓		✓
7	Web-based Information System for Blood Donation	✓	✓	✓			✓
8	International Institute for Communication and Development (IICD) Supported Programme: Integrated Blood Donor Data Base Management System-Zambia	✓	✓	✓			
9	PRCOBBMIS	✓	✓	✓	✓	✓	✓

The existing systems as shown in the comparison table have similar functions to PRCOBBMIS, but they still fall short since none of them were able to capture all six functions that PRCOBBMIS offers. Therefore, it was concluded that the PRCOBBMIS is the answer to all to the needs of PRC in terms of handling blood stock and donor data.
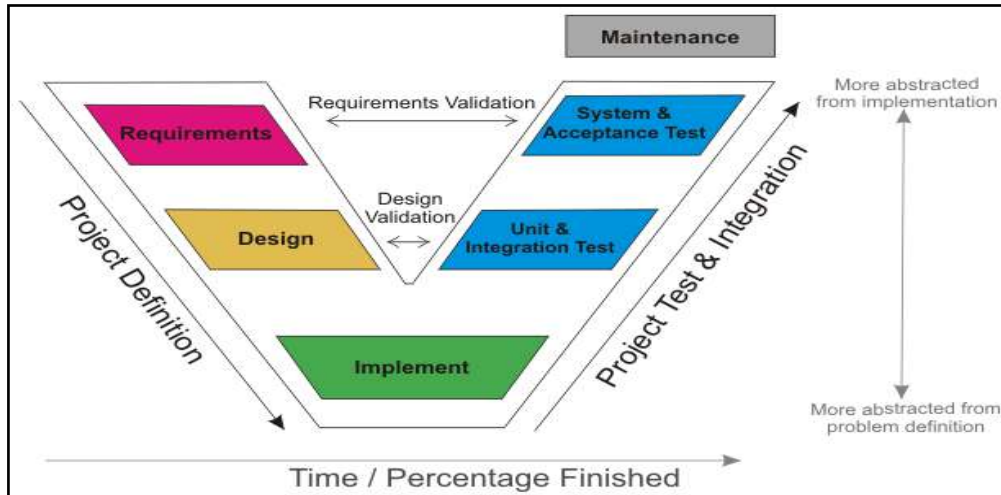

Figure 3. PRCOBBMISV Model for the System Development Life Cycle

Methodology

The PRCOBBMISV followed the Model for the system development life. V Model development methodology may be thought of as an extension of the waterfall model; it still breaks the implementation down into discrete phases. It recognizes that there is feedback from testing that feeds in at the requirements level, and it also shows at each stage the abstraction, different from the implementation. This model was chosen because it is easy to understand, the deliverables are easily defined for each stage, and there is an early stage of testing which improves the likelihood of success. The defects were detected at the early stage of this model, and unlike the waterfall model, planning and test designing happened before the coding. The phases of the study include Requirements gathering, Design, Implementation, System Acceptance Test, and Unit Integration Testing.

Requirements

In this phase, some of the employees of the Philippine Red Cross (PRC) Western Visayas Regional Blood Center were interviewed to gather information about the client. Based on the actual process used by the client, the current data flow diagram (see Figure 4 and Figure 5) was created. A copy of all the active forms used in their blood banking operations was given by the client; from the donor registration to the blood extraction, until the blood is ready for dispensing.
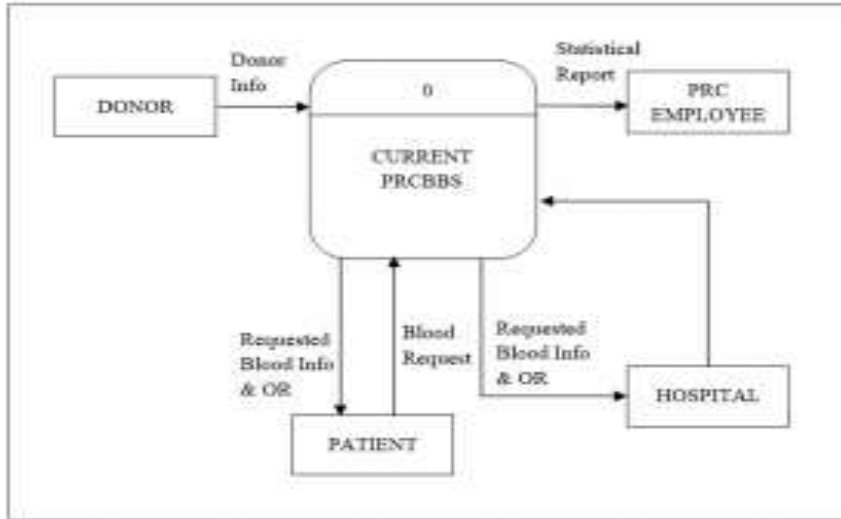
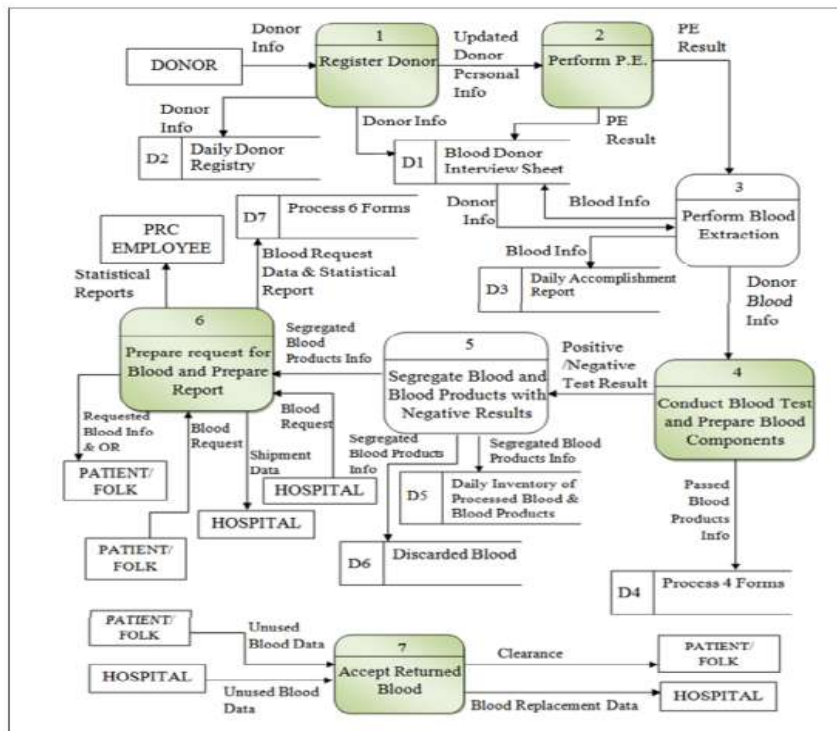*Figure 4. Contextual Diagram of Current PRC Blood Bank System*

Figure 5. Diagram Zero of Current PRCBBS

Design

The next phase of the V model is the design phase. In this phase, all the data gathered from PRC were studied and analyzed and able to generate a proposed data flow diagram. See Figure 6 and 7.
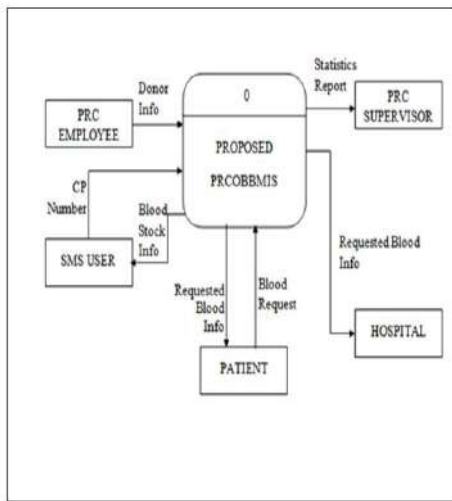

Figure 6.Contextual Diagram of Proposed PRC Online Blood Bank Management Information System
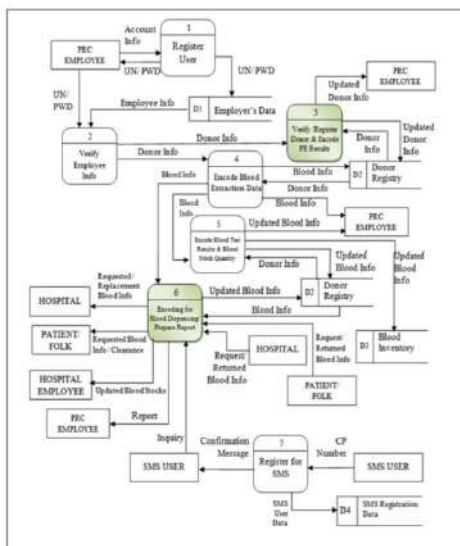

Figure 7. Diagram Zero of PRCOBBMIS

A prototype was also created and an interface for Home, User, Donor, Blood Donation, Blood Centers, Contact Us and About was designed. At the Home interface, functions such as Change Pass, Contacts, Coordinates, Report by Quantity and Report by Disease is integrated.

At the User interface, one can manage user accounts for the PRCOBBMIS. The Donor interface manages donor profile while the Blood Donation interface manages blood information. The Blood Centers, Contact Us and About interface displays all blood centers in the country, their contact information and history of PRC, respectively. A Gantt chart (see Appendix A) was also developed to be the basis of the timeline for the project.

Results and Discussion

The design from the prototype was converted using PHP language, and MySQL server was used for the database. Ozeki was used for the SMS integration in the system. Tabs were created for the major modules and functions. Buttons were created for some functions such as the Change Pass, Contacts, Coordinates, Report by Quantity and Report by Disease on the Home tab. On the User, Donor and Blood Donation tabs, View All button, New button, a search field and some links for editing was added. All buttons and links were tested and made sure that these were working and displaying the correct page.

Unit and Integration Test

The individual source code was tested to determine if they are fit for

use. The internal logic code was verified by testing every possible branch within the function. All possible data inputs were passed to all functions to test if the system is giving the correct output or if it is going to the correct link. The proponent begun the testing from the start of the process which is the registration of the User account (Staff, Supervisor, Administration), then followed by the registration and updating of donor accounts. Blood Donation module was also tested and made sure that data of blood stocks were updated in real time. Report generation was then tested.

After the unit testing, integration testing followed. Separate modules such as the Home, User, Donor, and Blood Donation and all the buttons and links were tested together to expose faults in the interfaces and the interaction between integrated components.

System and Acceptance Test

After the integration test was completed, the next test level was the system test. In this stage, the system specifications were compared against the actual system. System testing checks if the integrated product meets the specified requirements.

The last stage of the initial testing was the acceptance testing. In this stage, the system was presented to the client, and they were showing how the system worked and made sure that they have met the hardware and software requirements. Then the client let their staff, supervisors and some people from the administration try the system and have them make some evaluations. The client

suggested a few revisions, but they still decided to accept the system.

The initial testing was followed by the final testing. In this stage, the nonfunctional testing like stress, load and performance testing was performed. The revisions suggested by the client were already addressed. Final test execution reports and documents were prepared in this phase.

Launching and Maintenance

After the client was satisfied with the system, it was donated to them, specifically to the PRC Western Visayas Regional Blood Center in Iloilo City. All data will be stored in the cloud and FileZilla which is a free software; cross-platform FTP application will be used to update the system. However, since PRC is a non-profit organization, they will still have to look for financial donors that will help them launch and implement the system for actual use.

Philippine Red Cross Blood Bank Management Information System (PRCOBBMIS)

System Overview

The system can be accessed through three types of accounts: Staff, Supervisor, and Administrator. The system is composed of the following modules: Home, About, Donors, Blood Donation, Blood Centers, Inquiry, Users, Statistical Reports and Contact Us. The Staff and Supervisor accounts have some limitations on the accessibility of some modules, but the Administrator Account has access to everything. The developed system can add, edit and search records of

blood donors. Blood stocks can be monitored, and statistical reports can be generated with the use of the system.

System Features

The following are the features of the system:

- Efficient recording of blood donor data and laboratory results
- Sharing of donor and blood data in different PRC blood centers
- SMS and online inquiry of blood stocks
- Generate statistical reports for planning and decision-making purposes

System Objectives

Philippine Red Cross Online Blood Bank Management Information System aims to provide:

- Blood donor information
- Updated Blood stocks information
- Statistical reports with graphs and charts

Systems Functions

The system is divided into different subsystems which are then incorporated to attain the overall objective of the system. Three users must be able to log-in by entering their username and password on the log-in field. There are three types of accounts which have different levels of accessibility:

Administrator Account

The administrator has access to all modules, and he is the only one that can create supervisor and staff accounts. He is the only one that can upload events and activities of PRC on the website

Supervisor Account

The supervisor can access the donor and blood donation module. This account can create, update, and edit donor and blood donation data as well as view confidential laboratory results.

Staff Account

The staff account can also access the donor and blood donation module but with limitation. They can create and update donor and blood donation data, but they cannot edit and view confidential laboratory results.

Figure 8. The Log-in Screen

Donor Function

This function handles the registration process of blood donors. It allows adding, updating, editing and searching of donor's data. Donor history profile and PRC employee traceability can also be found in this function. Donor credits and clearances can be managed in this function.

Figure 9. Donor Screen

Blood Donation Function

This function manages laboratory results, shows traceability of blood records processed by PRC, and blood dispensing process.

Available blood stocks with its specific data can be searched and seen in this module. Registration and displaying a list of affiliated hospitals and its detailed information can be accessed here.

Figure 10. Blood Donation Screeen

Specific serial blood number can be searched in this function to see the blood status if is still available, has been dispensed or expired.

Inquiry Function

This function allows the user to search using SMS or online data for the quantity available of bloodstock of a certain blood type in a province or region. For online inquiry, the results can be displayed in a list (Figure 8) form and map (Figure 9) form.

Figure 11. Inquiry Screeen

Figure 12. View Map Screen

For SMS, registered users can text the inquiry to the system, and the user will receive the blood quantity of a particular blood type as seen in Figure 13.
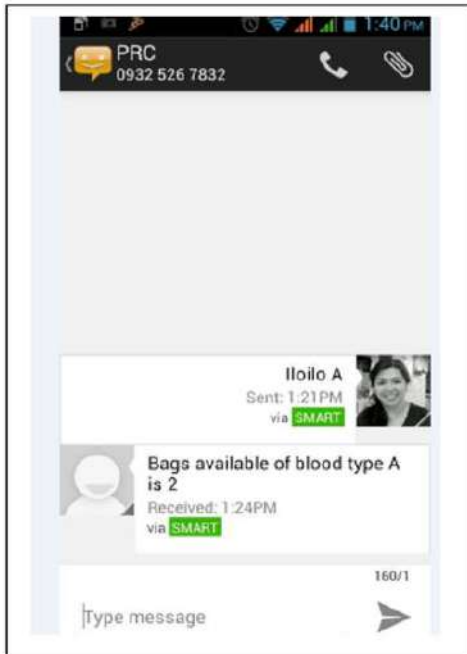

Figure 13. SMS Screeen

Statistical Report Function

This function as shown in Figure 14 allows the user to generate statistical reports in two ways: reports by quantity and reports by disease.

Reports by quantity display some blood stocks in a chosen location, date and blood type indifferent categories such as age group, gender, location, dispensed, expired, returned and donated. On the other hand, reports by disease generate the total number of blood that was positively tested of any of the five transfusion-transmissible diseases in a chosen location, date, gender, age group and blood type.

Type	18-24	25-34	35-44	45-60	Total
A	2	0	0	2	4
AB	2	0	0	0	2
B	0	0	0	0	0
O	1	0	0	0	1
A-	0	0	0	0	0
AB-	0	0	0	0	0
B-	0	0	0	0	0
O-	0	0	0	0	0
Total	5	0	0	2	7

Figure 14. Statistical Report Screen

Operating System: Microsoft Windows 7

Windows 7 is the next release of the Windows client operating system, built on the secure foundation of Windows Vista and Windows Server 2008. Performance, reliability, security, and compatibility are core tenets of this release as we collect your Feedback to meet the engineering goals of making Windows 7 the best-performing and most stable Windows operating system to date.

All the innovations in this product are meant to enhance IT professional capability to provide better service by the PRC and manage increasingly mobile PCs. It can protect data as it can enhance end-user and personal productivity.

Front End: Visual C#

C# (pronounced "C sharp") is a programming language that is designed for building a variety of

applications that run on the .NET Framework. C# is simple, powerful, type-safe, and object-oriented. The many innovations in C# enable rapid application development while retaining the expressiveness and elegance of C-style languages.

Visual C# is an implementation of the C# language by Microsoft. Visual Studio supports Visual C# with a full-featured code editor, compiler, project templates, designers, code wizards, a powerful and easy-to-use debugger, and other tools.

The .NET Framework class library provides easy access to many operating system services and it can improve the speed of the development cycle.

Physical Environment
Hardware Specification

Table 2
List of Hardware Requirements

	Minimum Requirements
CPU Type Model	Dual Core 2.3 GHz or Higher
Storage Type	500 GB Hard Disk or Higher
Input scanner	Mouse, Keyboard, Webcam, bar code
Output	Monitor,Printer

Software Specification

Table 3.
List of Software Requirements

	Minimum Requirements
Operating System	Microsoft Windows 7 or Higher
Programming Software	PHP, Visual C#, Ozeki
Database	MySQL

Back End: MySQL

MySQL is a database management system (DBMS). A database is a structured collection of data. It might be anything from a simple shopping list to a picture gallery, to the vast amounts of information in a corporate network.

To access, manipulate, and process data stored in a database, a DBMS is needed. Because computers are very efficient at handling large amounts of data, database management plays a central role in computing. But more than being a DBMS, MySQL is a relational database management system (RDBMS).

A relational database stores data in separate tables rather than

putting all the data into one large repository.

Doing so adds tremendous speed and flexibility. The tables are linked by defined relations, making it possible to combine data from several tables upon request.

User Technical Requirement

The intended users of the system are the PRC employees. The user must, at least, be able to know how to browse the internet and must have for data entries and printing of reports.

Cost and Benefit Analysis

In evaluating the detailed assessment of the financial resources spent on the development of this system, the cost per stage is determined by multiplying the estimated number of hours spent on that stage and the rate per hour which was inquired by the researcher from the PRC.

The system is found to be technically feasible since there is already an available hardware and software component which is needed to implement the system. In the long run, the intangible benefits of time and effort saved brought about by the implementation of the system surpasses the essential knowledge and skills to use computers with tangible benefits of paperless transactions in the PRC.

PRC employees can be more productive with their time spent in the workplace by not spending a lot of time manually preparing statistical reports.

The breakdown of the system's cost is shown in Table 4.

Table 4
Development Cost of the System

Stages	Time	Cost	Amount
Gathering of Requirements, Analysis and Consultations	430hrs	PHP 50.00	PHP16,000.00
Design of the System	160 hrs	PHP 50.00	PHP 8,000.00
Programming	1120 hrs	PHP 50.00	PHP 56,000.00
Testing and Evaluation	40 hrs	PHP 50.00	PHP 2,000.00
Polishing of Prototype and Implementation	120 hrs	PHP 50.00	PHP 6,000.00
TOTAL COST	1760 hrs	PHP 50.00	PHP 88,000.00

Architectural Design

The network layout of the system is shown in Figure 15.

The system is installed on the server and connected to the internet. A short message service (SMS) modem is also connected to cater mobile inquiries. Users can only access the system URL if they are connected to the internet.
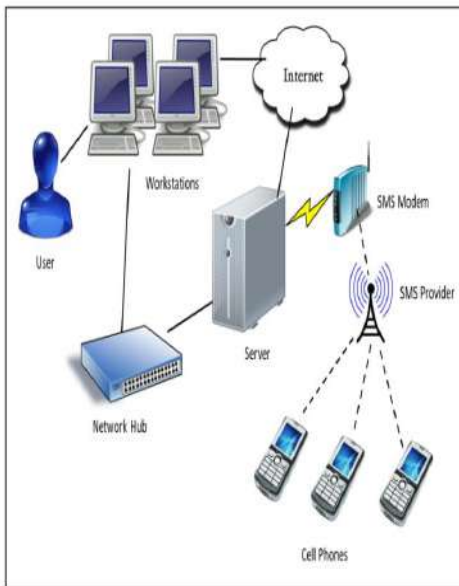

Figure 15. Setup with Online Hosting with SMS

Design and Implementation Issues

Several issues had been encountered during the development of the system. The first was the integration of the SMS feature to the PHP software of the system. Whenever the system receives an SMS inquiry, it cannot reply automatically. The solution is to process the SMS application on the desktop through a timer to make the processing more efficient. Another issue encountered is that when the barcode was being scanned to enter data, it automatically triggers the submit that will prevent the automatic triggering of the submit button. The solution is creating an algorithm button.

Conclusion

The Online Blood Bank Management Information System for Philippine Red Cross was able to:

- Efficiently record blood donor data and laboratory results
- Share donor and blood data in different PRC blood centers
- Use SMS and online inquiry of blood stocks
- Generate statistical reports for planning and decision-making purposes

The Blood Service Program of the Philippines operates by the provisions of the National Blood Services Act of 1994 or Republic Act (R.A.) 7719. In tripartite cooperation with the Department of Health and the Philippine Blood Coordination Council, the Philippine Red Cross (PRC) is one of the key organizations tasked to provide safe blood to the country through its active role in advocacy, promotion of voluntary blood donation, donor retention and care and the operation of a network of 74 Blood Service Facilities all over the country.

The Philippine Red Cross Online Blood Bank Management Information System (PRCOBBMIS) is a web-based environment that provides efficient profiling management and retrieval of data. It is a system designed to manage blood stock inquiries online and even through Short Messaging Service (SMS). PRCOBBMIS allows donor profiling and sharing of blood records to all blood centers and blood service

facilities of PRC nationwide. It also allows SMS query of blood stock quantity which makes data more accessible. The system can generate accurate statistical reports which can help in their planning and decision making.

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